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REVISIONS IN *POLEMONIUM* (POLEMONIACEAE): A NEW SPECIES AND A NEW VARIETY FROM CALIFORNIA

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Abstract

Polemonium eddyense Stubbs, sp. nov. (Polemoniaceae) is a localized endemic from Mt. Eddy in the Klamath Ranges of northern California. The new species resembles *P. chartaceum* H. Mason from the White and Sweetwater mountains. It is distinct from *P. chartaceum* in having round, rather than acuminate calyx lobes, heavier seeds, longer styles, and greater stigma exsertion. **Polemonium pulcherrimum** Hooker var. **shastense** (Eastw.) Stubbs, is a new combination from Mt. Shasta and Mt. Lassen. It differs from other varieties of *P. pulcherrimum* in corolla color, as well as geography, elevation, stature, and pubescence.

Key Words: Alpine flora, Mt. Eddy, Mt. Shasta, phylogeny, Polemoniaceae, *Polemonium*, *Polemonium chartaceum*, *Polemonium pulcherrimum*.

Over the past several decades there has been an ongoing series of systematic relationships proposed within *Polemonium* (Polemoniaceae). Pritchett (1993) and Pritchett and Patterson (1998) first undertook a morphometric analysis of relationships of alpine species in western North America. De Geofroy (1998) followed with a survey of western North American species using molecular sequence data. Timme (2001) expanded on de Geofroy's molecular research by examining relationships across the entire genus. Finally, Worley et al. (2009) published a phylogeny of the genus using AFLPs. These efforts have resulted in a substantial understanding of the taxonomy of the genus in California and western North America. *The Jepson Manual: Vascular Plants of California, 2nd ed.* (Timme and Wilken 2012) recognizes seven species of *Polemonium* in California.

In the most recent study, Stubbs (2012) undertook a thorough examination of remote populations in the field and used both morphological data and an updated molecular phylogeny of the genus, including taxa heretofore unsampled, to address three taxonomic problems that had not been resolved during earlier studies: 1) the issue of whether *P. carneum* A. Gray still occurred in California; 2) the status of the Mt. Eddy sky pilot; and 3) whether or not there are previously recognized infraspecific taxa within *P. pulcherrimum* Hook. worthy of recognition. As to the first issue, Stubbs and Fallscheer (2011) reported the occurrence of several healthy populations of *P. carneum* in northern California. Results of the rest of Stubbs' phylogenetic study have been published elsewhere (Irwin et al. 2012); here we propose new names so that they can be included in the forthcoming *Flora of North America North of Mexico, vol. 15* (FNANM).

Taxonomy

New Species

Polemonium eddyense Stubbs, sp. nov.—TYPE: USA, California, Siskiyou Co., Klamath Mountains, summit of Mt. Eddy; 2750 m; 15 July 2010, *Rebecca Stubbs 015* (holotype CAS; isotype MO).

Cespitose perennials 6.5–11 cm tall, densely viscid hairy; peduncles simple, not branching, glandular-pubescent throughout. Most leaves in basal rosettes, 14–46 mm long, 3–6 mm wide; petioles 5–10 mm, sheathing at base; leaflets 16–26, 1–6 mm long, 0.5–5 mm wide, 1–3 at point of attachment to rachis, lobes entire and obtuse or spatulate, terminal leaflet free but deeply lobed. Inflorescences capitiform, pedicels 3–6 mm. Perianth and androecium 5-merous, gynoecium 3-merous. Calyx 4.5–7.5 mm long, lobes lanceolate to obtuse, rounded, circumference 7–10 mm, hairy; corolla funnelform, petals 5, lobes violet, throat yellow, corolla circumference 7.8–11.3 mm, tube 5.9–11 mm long, lobes 3.5–6 mm long, 3–4.7 mm wide; stamens 5, exserted, anthers yellow, filaments glabrous, 3.4–8.1 mm long, attached 2.8–7.1 mm above corolla tube base; style exserted, 5.6–11.7 mm long, stigma 3-parted, 1.3–2 mm long. Seeds not mucilaginous when wet, lenticular, 2–3 mm long, 0.5–1.0 mm wide, dark brown.

Mt. Eddy, in the Klamath Range, is the only known location of *P. eddyense*. Historically, this population was referred to as *P. chartaceum* H. Mason, a species also found in the Sweetwater and White mountains, approximately 500 km to the south (Fig. 1). Pritchett (1993) and Pritchett and Patterson (1998) noted differences in average calyx lobe shape, seed weight, style length, and stigma exsertion in the Mt. Eddy population

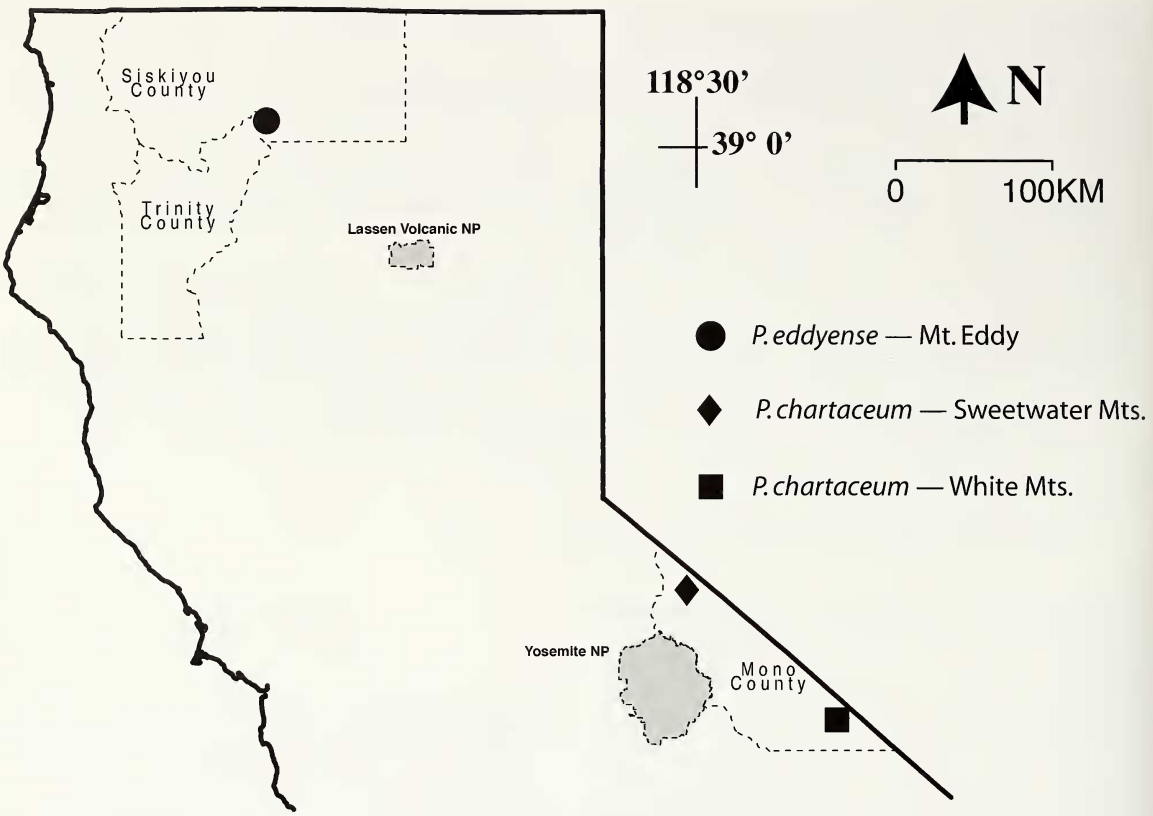

FIG. 1. Locations of *Polemonium eddyense* (Mt. Eddy) and *P. chartaceum* (Sweetwater and White mountains).

(Table 1). The most notable characteristic in the field is the long style and strongly exserted stigma in *P. eddyense* (Fig. 2A). In contrast, in *P. chartaceum* the style and stigma do not usually exceed the corolla orifice (Fig. 2B). Additionally, molecular sequence data from the ITS region (Irwin et al. 2012; Table 2) supports that the Klamath population is not phylogenetically close to the Sweetwater and White mountains populations of *P. chartaceum* (Fig. 3). Based on morphology, molecular research, and biogeography, it is clear that the Mt. Eddy population warrants taxonomic recognition as a new species.

Paratypes: USA. CALIFORNIA. Siskiyou Co.: Klamath Mtns., T40N R5W S18 NE¼, 0.8 km E of Mt. Eddy; 2707 m, 23 June 1990, *Daniel W. Pritchett 100*. Trinity Co.: T40N R6W S13 NE¼, unnamed peak 1.6 km NW of Mt. Eddy, on summit and down SW slope, 24 June 1990, *Daniel W. Pritchett 101*.

Mt. Eddy is the highest and most northerly peak in the Klamath Province and is composed predominantly of serpentinized peridotite. Mt. Eddy contains twenty-one species that have California Rare Plant Ranks (CNPS 2012), many of which, like *P. eddyense*, are endemic to serpentine soils (Cheng 1996; DellaSala et al. 1999). Recognition of *P. eddyense* as being distinct from *P. chartaceum* has significant implications for conservation due to this being the only known location of this species.

New Combination

Polemonium pulcherrimum Hook. var. **shastense** (Eastw.) Stubbs, stat et comb. nov. *Polemonium shastense* Eastw. Bull. Torrey Bot. Club 32:205–206. 1905. *Polemonium pulcherrimum* subvar. *shastense* (Eastw.) Brand. Das Pflanzenreich 250:34–36. 1907. *Polemonium shas-*

TABLE 1. MORPHOLOGICAL DIFFERENCES BETWEEN *POLEMONIUM EDDYENSE* AND TWO *P. CHARTACEUM* POPULATIONS (PRITCHETT 1993).

	Calyx apices	Seed weight	Style length	Stigma exsertion
P. eddyense Klamath Mtns.	rounded	9.62 mg	9.63 mm	2.91 mm
P. chartaceum Sweetwater Mtns.	acuminate	N/A	6.71 mm	0.29 mm
P. chartaceum White Mtns.	acuminate	3.92 mg	7.81 mm	1.59 mm

FIG. 2. Detailed photos of *Polemonium* subsp. A. *P. eddyense* showing strongly exserted stigma. B. *P. chartaceum* with stigma not exceeding corolla orifice. C. *P. pulcherrimum* var. *shastense* with pink venation radiating from corolla tube.

TABLE 2. COLLECTION NUMBER FOR VOUCHER SPECIMEN AND GENBANK ACCESSION NUMBER FOR ITS SEQUENCE (IRWIN ET AL. 2012).

Taxon	Collection number	GenBank ITS
P. acutiflorum	*de Nevers 2073*	DQ320767
P. boreale	*Cody 26927*	DQ320769
P. brandegeei	*Worley 006*	DQ320771
P. caeruleum	*McNeal 3530* (BRY)	EU628253
P. californicum	*Stubbs 12* (SFSU)	JX879092
P. californicum	*Stubbs 18* (SFSU)	JX879107
P. carneum	*Stubbs 07* (SFSU)	JX879106
P. carneum	*Stubbs 10* (SFSU)	JX879108
P. carneum	*Stubbs 11* (SFSU)	JX879104
P. chartaceum	*Stubbs 24* (SFSU)	JX879095
P. chartaceum	*Stubbs 23* (SFSU)	JX879102
P. chinense	*Ting-nong 1543*	DQ32078
P. eddyense	*Stubbs 15* (SFSU)	JX879096
P. elegans	*Worley 18*	DQ320783
P. elusum	*Irwin 5038* (RM)	JX879101
P. elusum	*Irwin 5039* (RM)	JX879111
P. elusum	*Irwin 5148* (RM)	JX879089
P. elusum	*Irwin 5496* (RM)	JX879099
P. eximium	*Stubbs 14* (SFSU)	JX879094
P. eximium	*Stubbs 21* (SFSU)	JX879109
P. eximium	*Stubbs 22* (SFSU)	JX879100
P. foliosissimum	*Halse 4261*	DQ320787
P. grandiflorum	*Zamudio 7469*	DQ320788
P. mexicanum	*Koch 75399*	DQ320789
P. micranthum	*Stubbs 04* (SFSU)	JX879093
P. micranthum	*Stubbs 05* (SFSU)	JX879113
P. micranthum	*Taylor 12548*	DQ320791
P. occidentale	*Stubbs 17* (SFSU)	JX879110
P. occidentale	*Timme 015*	DQ320793
P. occidentale	*Stubbs 13* (SFSU)	JX879112
P. pauciflorum	*LeBuhn s.n.*	DQ320794
P. pectinatum	*Worley 001*	DQ320796
P. pulcherrimum var. *delicatum*	*de Geofroy 127*	DQ320797
P. pulcherrimum var. *lindleyi*	*Grimes 2159*	DQ320801
P. pulcherrimum var. *pulcherrimum*	*Stubbs 19* (SFSU)	JX879091
P. pulcherrimum var. *pulcherrimum*	*Stubbs 20* (SFSU)	JX879103
P. pulcherrimum var. *pulcherrimum*	*Stubbs 33* (SFSU)	JX879097
P. pulcherrimum var. *shastense*	*Stubbs 16* (SFSU)	JX879105
P. pulcherrimum var. *shastense*	*Stubbs 26* (SFSU)	JX879098
P. reptans	*Keil 6266*	DQ320805
P. viscosum	*Worley 004*	DQ320806
Leptosiphon croceus	*Hankamp 043* (SFSU)	JX879090
Linanthus caespitosus	*Wilken 13982* (SFSU)	AF119443
Linanthus jonesii	*Owings 047* (SFSU)	AF119430
Phlox diffusa	*Peterson 97–110* (SFSU)	AF119444

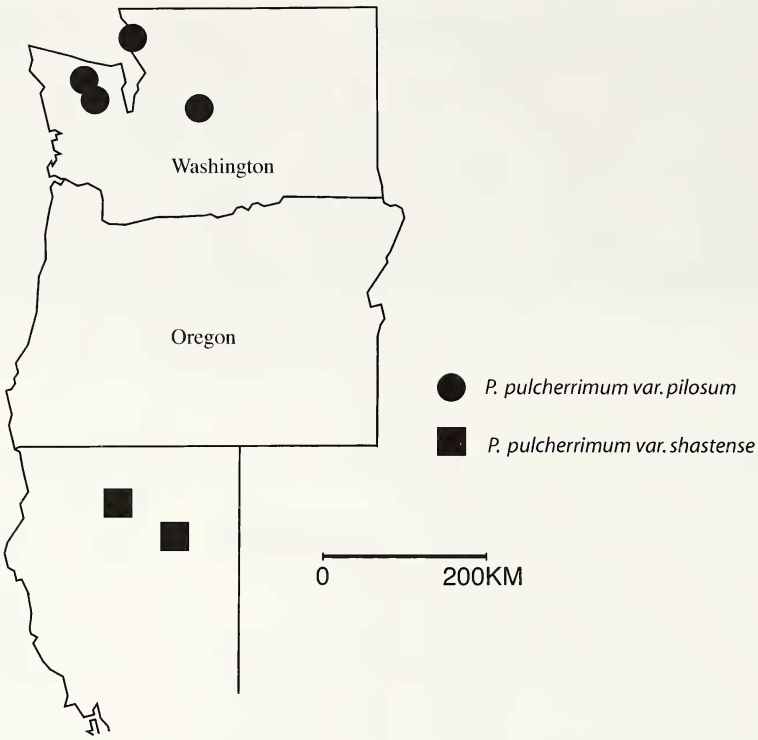

FIG. 3. Locations of *Polemonium pulcherrimum* var. *pilosum* in Washington and *P. p.* var. *shastense* in California.

tense f. *shastense* (Eastw.) Wherry Amer. Midl. Naturalist 27:753. 1942.—Type: USA, California, Siskiyou Co., Mt. Shasta, 10,400 ft, 16 July 1903, *Copeland s.n.* distributed as *Baker's 3515* (holotype: CAS!)

Polemonium pulcherrimum is a primarily subalpine and montane species and is widespread throughout western North America. Based on the amount of morphological variation in this species, there have been up to 35 intraspecific names and synonyms described (Brand 1907; Wherry 1942; Davidson 1950; Grant 1989). Many of the varieties and subspecies for *P. pulcherrimum* are readily discounted based on an acceptable spectrum of phenotypic variation expected for a species with an extensive range. Out of the plethora of proposed names published over the past century, five varieties appear distinct: *P. p.* var. *delicatum* (Rydb.) Cronquist, *P. p.* var. *lindleyi* (Wherry) J. P. Anderson, *P. p.* var. *pilosum* (Greenm.) Brand, *P. p.* var. *pulcherrimum*, and *P. p.* var. *shastense*.

Historically, two varieties have been recognized in California: *P. p.* var. *pulcherrimum* and *P. p.* var. *pilosum*. Very few collections have been made of *P. p.* var. *pilosum*, the only white-flowered morph of *P. pulcherrimum*, and it has not been sampled to be included in molecular-based phylogenetic analyses. In California, what formerly passed as *P. p.* var. *pilosum* occurs only on Mt. Shasta and Mt. Lassen. Populations from these locations differ from populations in Washington in size, petiole length, pubescence type, corolla color, and elevational range. Additionally, we have examined two specimens from California labeled as *P. pulcherrimum* var. *pilosum* (*Taylor 4690* JEPS, *Barbe 325* RSA) that might be *P. p.* var. *shastense*, but this is difficult to confirm without seeing live material.

Similar to the nomenclatural confusion surrounding the varieties of *P. pulcherrimum*, the specific epithets "*shastense*" and "*pilosum*" have a convoluted history. It began in 1898 when Greenman first recognized *P. viscosum* Nutt. var. *pilosum* Greenm. from Goat Mountain in Washington, noting the pilose pubescence and white corolla with a yellow throat. He pointed out that "somewhat intermediate between the above variety and the species proper are specimens from Lassen's Peak, California." The use of the name *P. viscosum* for this plant produced confusion. *Polemonium viscosum* is a sky pilot from the Rocky Mountains and north into Canada and differs substantially from *P. pulcherrimum* in leaf attachment, leaflet shape, and inflorescence shape. This mistake can be attributed to an error on the herbarium sheet in the Gray Herbarium that was mentioned in the new species description (Rydberg 1897; Wherry 1942). The sheet, labeled *Polemonium viscosum*, inexplicably included two plants ("Evidently an accident occurred in the mounting room" cf. Wherry

TABLE 3. DIFFERENCES BETWEEN *POLEMONIUM PULCHERRIMUM* VAR. *PILOSUM* AND *P. P.* VAR. *SHASTENSE*.

	P. p. var. *pilosum*	*P. p.* var. *shastense*
General location	Washington	California
Elevation	1524–1828 m	2590–3900 m
Plant size	6–13 cm	7–18 cm
Petiole length	8–10 mm	10–33 mm
Pubescence	viscid glandular	densely woolly
Corolla color	white	white with pink

1942), one fitting Nuttall's original description of *P. viscosum* and the other fitting *P. pulcherrimum* var. *shastense* (Wherry 1942).

In 1905, Eastwood described *P. shastense* Eastw. from Mt. Shasta, California, distinguishing it as having glandular pubescence with a white corolla "often tinged with pink." Two years later Brand (1907) recognized *P. pulcherrimum* subvar. *shastense* Brand, addressing for the first time the distinction between what is now being recognized as *P. p.* var. *shastense* and *P. p.* var. *pilosum,* the former densely woolly with white flowers and the latter viscid glandular.

Jones (1936) elevated the Washington populations to species level, *P. pilosum* (Greenm.) G. N. Jones, but less than a decade later Wherry (1942) used Eastwood's *P. shastense* and applied this name to not only the plants in California but also to those in the Cascade Mountains. Like Brand, he recognized that the populations from the two states differed and distinguished the Washington material as *P. shastense* f. *pilosum* and the California material as *P. shastense* f. *shastense*, with taxon *pilosum* having leaflets more acute than those of taxon *shastense*.

Davidson (1950), in his monograph of the genus, included 16 synonyms under *P. pulcherrimum*, recognizing only *P. delicatum* Rydb.as a distinct taxon. Grant's (1989) study of the alpine polemoniums mentioned *P. pulcherrimum* var. *pilosum* "from the Cascade region of Washington and northeastern California," but only to say that it was being placed into synonymy and was a good candidate for taxonomic recognition.

Upon thorough reexamination of these taxa, particularly of extant populations in the field, it is apparent that varieties *pilosum* and *shastense* are distinct based on an array of features. The Californian entities are larger, both in habit and in size of organs (Table 3). *Polemonium pulcherrimum* var. *shastense* grows to 18 cm tall, while *P. p.* var. *pilosum* grows to 13 cm. Longer petioles, from 10–33 mm, occur in var. *shastense*, while in var. *pilosum* the petioles range from 8–10 mm. There is also a difference in the pubescence between the two varieties: var. *pilosum* is densely woolly and var. *shastense* is viscid glandular.

The most noticeable difference is corolla color. The description of the type specimen of *P. p.* var. *pilosum* describes the corolla as white with a yellow throat (Greenman 1898). Eastwood (1904) described the corolla of the California species as white with pink veins or tinges of pink. The Washington material never has pink in its corollas, while the California material generally has shades of pink (Brand 1907; Jones 1936). The bright pink venation (Fig. 2C) or pink tinge in the corolla of *P. p.* var. *shastense* is present in every population, though not in every individual flower. On Mt. Shasta, the corollas are white with bright pink striations along the veins, while on Mt. Lassen the corollas are often tinged with pink but never with a distinct separation between the pink and white parts of the corolla. Additionally, these two taxa are also separated by over 800 km, and there are no white-flowered *P. pulcherrimum* populations in Oregon (Fig. 3). Overall, the differences between these taxa are of similar scope with differences that distinguish other varieties of *P. pulcherrimum.* To conform to the FNANM policy that all infraspecific taxa within a genus be at the same rank, recognition of a new combination is warranted.

Due to its small population sizes and its distribution restricted to two heavily used alpine areas, Mt. Lassen and Mt. Shasta, *Polemonium pulcherrimum* var. *shastense* warrants conservation status.

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